Laryngeal Cancer in Virginia 1970-1996

Virginia Department of Health
E. Anne Peterson, MD, MPH
Acting Commissioner

April 1999

Virginia Cancer Registry
Office of Epidemiology
P.O. Box 2448, Room 114
Richmond, Virginia 23218

http://www.vdh.state.va.us/epi/vcr.htm

TEL (804) 786-1668
FAX (804) 371-4061

Contributors

Principal Author

Sarah L. W. Norris
Statistical Analyst, Senior
Virginia Cancer Registry

Contributing Editors

Amy M. Pugh, MA
Director
Virginia Cancer Registry

Diane Woolard, PhD, MPH
Director, Division of Disease Surveillance and Investigation
Office of Epidemiology
Virginia Department of Health

Laurence J. DiNardo, MD, FACS
Vice-Chairman, Department of Otolaryngology Head and Neck Surgery
Medical College of Virginia
Virginia Commonwealth University

Virginia Cancer Registry Staff

Bonita Bryant, CTR
Medical Records Technician, Senior

Bonnie Perry, ART
Medical Records Technician, Senior

Leona Rowe, CTR
Medical Records Technician, Senior

Phillip Jones, CTR
Medical Records Technician, Senior

Vivian Purnell
Program Support Technician

Melinda Swingle, CTR
Medical Records Technician, Senior

Acknowledgments

The editors wish to thank the staff of the hospital cancer registries, ambulatory surgery centers, pathology laboratories, and physician offices throughout Virginia who provided the cancer incidence data for this report. The production of this report would not have been possible without their efforts to ensure the quality and completeness of the incidence data.

This publication was made possible by grant number U75/CCU310694 from the Centers for Disease Control and Prevention's National Program of Cancer Registries.

Table of Contents

Forward

It is with great pride that I present the Virginia Cancer Registry's *Laryngeal Cancer in Virginia, 1970-1996.* This document underscores the power of the Registry and the dedication of its staff to provide a better understanding of cancer in the State of Virginia. Indeed, incidence rates of laryngeal cancer in our state were found to be significantly higher than in the nation as a whole. When considered in its entirety, this report provides important insight into regional variations in the incidence and treatment of a disease which continues to afflict Virginians at a steady rate despite its decline nationwide. As such, I believe readers will find this study to be both informative and thought-provoking.

LAURENCE J. DINARDO, M.D., F.A.C.S.

Introduction

Laryngeal cancer is a highly preventable disease caused primarily by the effects of tobacco and alcohol use. In 1999, an estimated 10,600 Americans will be diagnosed with laryngeal cancer, and 4,200 Americans are expected to lose their lives as a result of the disease.[1] Nationally, laryngeal cancer typically represents almost 1% of all new cancer cases and 0.75% of all cancer-related deaths each year.[2] From the mid-1970s to the mid-1980s, laryngeal cancer incidence rates in the U.S. rose slightly from 4.5 cases per 100,000 persons (1975) to 4.9 cases per 100,000 persons (1985). Since 1985, however, rates have declined to 3.8 cases per 100,000 persons in 1995. U.S. mortality rates due to laryngeal cancer have remained stable, varying only from 1.5 deaths per 100,000 persons in 1975 to 1.3 deaths per 100,000 persons in 1995.

This report of the Virginia Cancer Registry (VCR) examines the occurrence of laryngeal cancer in Virginia residents between 1970 and 1996 and relates trends in detection, treatment, and survival to nationwide patterns. The discussion of these data includes background information on etiology, risk factors, and clinical features of the disease, as well as methods of prevention, diagnosis, and treatment. These analyses will serve three main purposes: (1) document laryngeal cancer incidence in the Commonwealth of Virginia, (2) facilitate the assessment by hospitals and communities of their own cancer prevention and treatment efforts, and (3) highlight areas for improved prevention and control efforts. The report concludes with recommendations for future research by Laurence DiNardo, MD, Vice-Chairman of the Department of Otolaryngology Head and Neck Surgery at Virginia Commonwealth University's Medical College of Virginia.

Methods

The Virginia Cancer Registry has collected demographic and clinical information on cancer patients diagnosed or treated in Virginia since 1970. The VCR became a population-based registry in 1990 when reporting of newly-diagnosed cancer cases was made mandatory for hospitals, clinics, and laboratories.[3] In order to improve the completeness of case reporting to the VCR, in 1998 the Virginia legislature amended the cancer registry law to require reporting by physician offices. Also, data on cancer in Virginia residents diagnosed or treated in the neighboring states of West Virginia, Kentucky, North Carolina, Maryland, or the District of Columbia are collected from the central registries in those states.

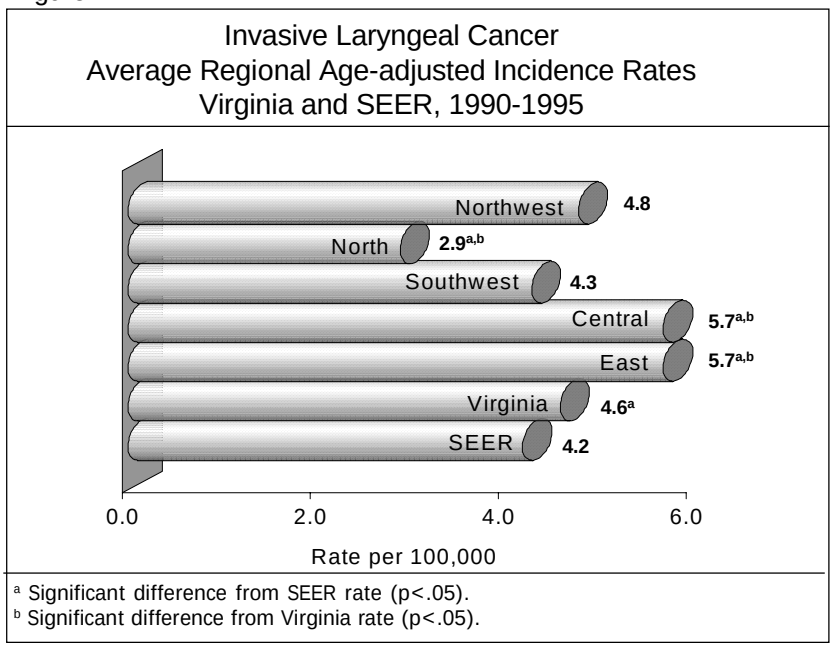
Virginia residents selected for study were diagnosed with a tumor of ICD-O-2[4] typography code C32.0-32.9, excluding histology codes 9590-9989. Detailed analyses are provided for the three most common laryngeal subsites: glottis (containing the vocal cords), supraglottis (from pharynx to vocal cords), and subglottis (from vocal cords to trachea). While all eligible cases diagnosed between 1970 and 1996 are included in general tables, only population-based data reported for cases diagnosed between 1990 and 1995 are used for comparison purposes. These statistics provide a more complete assessment of cancer incidence in Virginia, and thus are more appropriate for national comparison.

The most recent data from the National Cancer Institute's Surveillance, Epidemiology, and End Results Program (SEER) and the American College of Surgeon's National Cancer Data Base (NCDB) are included for comparison purposes where appropriate. Data from SEER cover the years 1990 to 1995, while data from NCDB were available for 1990 through 1992. In order to exclude cases with inadequate follow-up, survival analysis was performed only for cases diagnosed between 1970 and 1989. Data were analyzed using Rocky Mountain Cancer Data System[5] programs, SPSS[6] statistical software, and SEERPrep[7] and SEERStat[8] cancer data analysis software. Appendix A contains technical notes and information on population estimates, calculation of rates, estimates of completeness, and definitions of terms used.

Results

From 1990 to 1996, a total of 2,229 Virginia residents were diagnosed with laryngeal cancer, for an average of 318 new cases each year. These cases accounted for an average of 1.3% of all new cancer cases during these years, with little variation from year to year (See Appendix C, Table C-1). The average annual incidence rate of invasive laryngeal cancer was 4.6 cases per 100,000 persons, based on data reported from 1990 to 1995. Unlike national figures, Virginia rates have not shown an overall decline during these years.

Figure 1



Geographic Distribution

The localities in Virginia are combined into five health planning regions (See Appendix B). Figure 1 shows that the state average annual age-adjusted rate of 4.6 cases per 100,000 persons for 1990-1995 was significantly higher than the SEER rate of 4.2 cases per 100,000 persons for the same time period. The Central and Eastern regions showed rates that were higher than both the state rate and the SEER rate, while the Northern region rate was significantly lower than both state and SEER rates. When annual regional age-adjusted incidence rates were compared to the annual state rates, the Northern region showed consistently lower incidence rates each year from 1992 to 1995. Detailed annual regional rate comparisons and health district comparisons are provided in Tables C-2 and C-3 in Appendix C.

Demographics

In a pattern that follows the national trend[2], from 1970 to 1996, 65% of cancer of the larynx in Virginia was diagnosed in persons between 55 and 74 years of age (See Appendix Table C-4). Although Figure 2 shows that from 1990 to 1995 the age-specific rates for all age groups between 30 and 74 years were higher for Virginia than for SEER, the difference is statistically significant only for the 70-74 year age group.

Figure 2

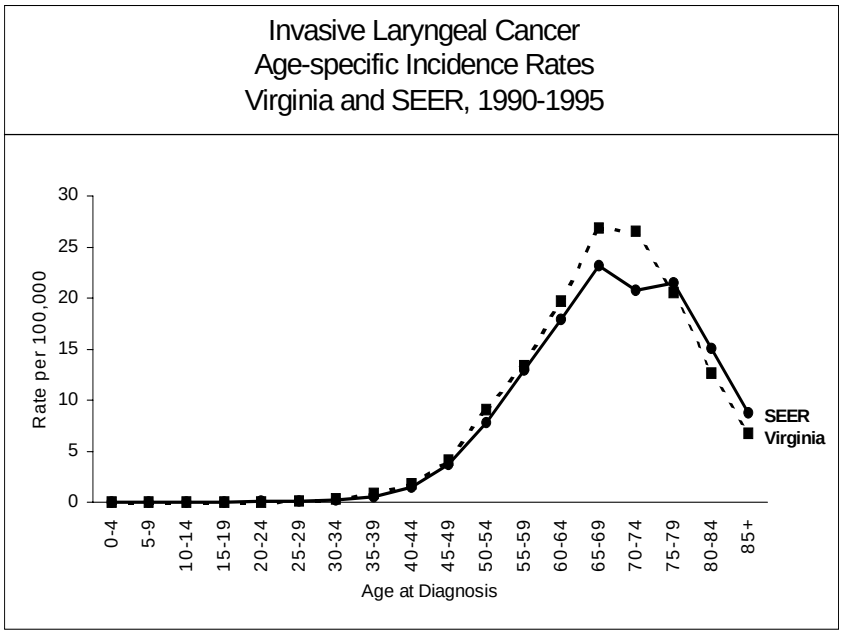


Table 1

Distribution of Laryngeal Cancer
Count and Percentage by Sex and Race,
Virginia, 1970-1996
Invasive Incidence Rate by Sex and Race,
Virginia and SEER, 1990-1995

	1970-1996		1990-1995 Rate per 100,000		
			Virginia		SEER
	Count	%	Count	Rate	Rate
SEX					
Male	4,633	*81.0*	1,410	8.1 [a]	7.4
Female	1,088	*19.0*	392	1.8	1.5
RACE					
White	4,380	*76.6*	1,377	4.3	4.1
Black	1,305	*22.8*	405	6.4	7.0
Other	20	*0.3*	7	0.9	1.5
VIRGINIA	5,721	*100.0*	1,802	4.6 [a]	4.2

Note. Count and percentage data for 1970-1996 include in situ carcinomas. Total figures include 16 cases of unknown race. Rates are age-adjusted to the 1970 US population and are based on invasive cases only.
[a] Significant difference from SEER rate (p<.05).

Nationally and statewide, cancer of the larynx is diagnosed more than four times more often in males than females. As Table 1 demonstrates, eighty-one percent of laryngeal cancer cases in Virginia were male, and the incidence rate for males in Virginia was significantly higher than the SEER rate (8.1 vs. 7.4 cases per 100,000 persons, respectively). While less than one in four laryngeal cancers were diagnosed in the black population, the burden of this disease was heaviest among blacks. Statewide, the rate of laryngeal cancer was 49% higher for the black population than for the white population. National rates have shown a greater disparity, with rates for blacks being 71% higher than those for whites.

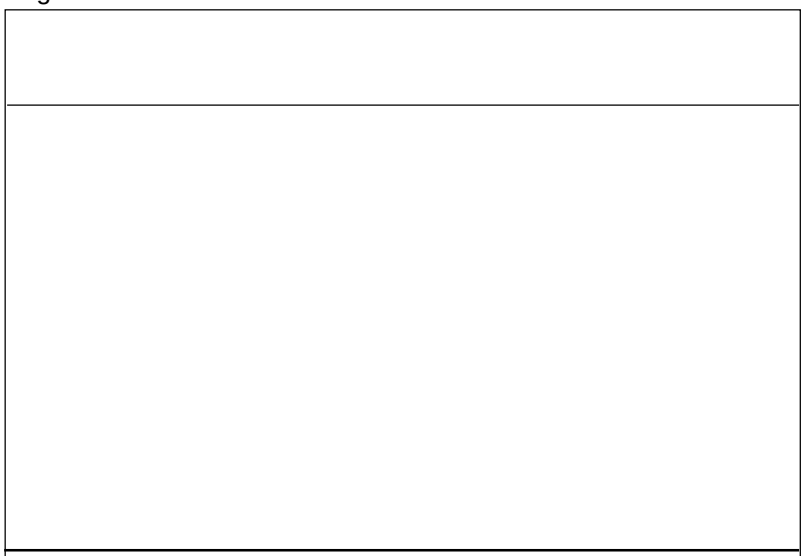
Histology

In Virginia, the distribution of laryngeal cancer cell types showed that 95% of reported laryngeal cancer were histologically classified as squamous cell carcinoma. Another 3.5% were classified as carcinoma, not otherwise specified (NOS) (See Appendix Table C-5). This distribution conformed to SEER comparison data.

Anatomic Distribution

Figure 3 illustrates the differences in anatomical distribution of laryngeal cancer between men and women. In Virginia, glottic cancer was the most common laryngeal tumor diagnosed in men and the second most common in women. Glottic tumors accounted for nearly half of all laryngeal cancer diagnosed in males. For Virginia women, supraglottic tumors were the most common laryngeal cancer. In fact, supraglottic cancer accounted for nearly half of all laryngeal cancer diagnosed in women. For men, supraglottic tumors were the second most frequently diagnosed laryngeal cancer. Appendix Table C-6 provides subsite distributions by age groups for males and females.

Figure 3



Note. Data include in situ carcinomas.
*All other subsites include laryngeal cartilage, overlapping lesion and larynx, not otherwise specified (NOS).

Subglottic tumors were considered rare and accounted for 1.3% of all laryngeal cancer in Virginia. Two other subsite categories of laryngeal cancer are the laryngeal cartilage and overlapping lesions of the larynx. A very small percentage of tumors were classified in either category; however, the subsite was not specified for nearly one-quarter of all laryngeal cancers.

Demographic and temporal views of the anatomic distribution of laryngeal cancer are provided in Appendix Table C-7. Although the male to female ratio was the same between whites and blacks, the black population in Virginia had a lower proportion of glottic cancer than the white population. However, blacks had a higher percentage of laryngeal cancer of unspecified site. Within the state, the Northwestern health region reported a higher percentage of supraglottic cancer than the other regions . There did not appear to be a trend in anatomic distribution for the state between 1990 and 1996. Trends found in Virginia data were similar to those reported by NCDB[9] and SEER.

Staging

Two distinct types of staging have been reported to the VCR for laryngeal cases: SEER Summary Stage (in situ, local, regional and distant) and AJCC Stage Grouping (Stages 0-IV). Appendix A contains an explanation of staging guidelines. Table 2 shows that among the laryngeal cancer cases diagnosed between 1990 and 1996, AJCC stage data were reported for 80% of cases, while SEER stage data were noted in 96% of cases. Because AJCC stage data are more detailed and are used more frequently in Virginia hospital and clinical studies, detailed analysis of 1990-1996 Virginia data are presented using AJCC Stage Groupings.

Table 2

Distribution of Laryngeal Cancer, Virginia
Count and Percentage by Stage at Diagnosis
AJCC and SEER Staging Conventions

	Virginia 1990-1996		NCDB 1990-1992
AJCC Stage Grouping	Count	%	%
Stage 0	88	*4.9*	*6.0*
Stage I	643	*35.9*	*38.4*
Stage II	327	*18.2*	*18.1*
Stage III	323	*18.0*	*17.0*
Stage IV	411	*22.9*	*20.5*
TOTAL	1,792	*100.0*	*100.0*

Note. Virginia data exclude 437 cases (19.6% of all laryngeal cancer) that are unstaged or missing stage data. In reported NCDB data, 246 cases (2.6% of all laryngeal cancer) are unstaged or missing stage data.

	Virginia 1990-1996		SEER 1990-1995
SEER Summary Stage	Count	%	%
In situ	122	*5.7*	9.1
Local	1,274	*59.6*	*61.1*
Regional	588	*27.5*	*15.5*
Distant	155	*7.2*	*14.3*
TOTAL	2,139	*100.0*	*100.0*

Note. Virginia data exclude 90 cases (4.0% of all laryngeal cancer) that are unstaged or missing stage data. In reported SEER data, 409 cases (5.9% of all laryngeal cancer) are unstaged or missing stage data.

Overall, fifty-nine percent of Virginia laryngeal cancer cases were classified as early stage (Stages 0, I, or II). Virginia data showed a slightly higher percentage (40.9%) of laryngeal cancer detected in Stages III and IV than reported by the NCDB[9](37.5%); however, the difference was not statistically significant. Early detection is strongly influenced by subsite. Glottic cancer, which causes the most perceptible symptoms, was the laryngeal cancer most frequently diagnosed in the early stages. In Virginia, 80% of glottic tumors diagnosed between 1990 and 1996 were in the early stages (See Appendix Table C-8). The laryngeal cancer most often diagnosed in the late stages (Stages III or IV) was subglottic cancer. Cancer in this subsite causes few symptoms until the disease has progressed. Sixty-three percent of Virginia subglottic cancer cases diagnosed between 1990 and 1996 were in the late stages.

When stage was analyzed by demographic variables, several trends emerged. A greater percentage of males (60.6%) were diagnosed with early stage laryngeal cancer compared to females (53.2%). Conversely, a greater percentage of females were diagnosed with late stage laryngeal cancer than were males. This trend may be partially due to the subsite distribution in men and women. Glottic cancer, which was more often diagnosed in the early stages, was the most common laryngeal cancer in men. The most common laryngeal cancer for women was supraglottic, which was usually not diagnosed until the

late stages. The black population tended to have a greater percentage of laryngeal cancer detected in Stage IV (32.8%) than the white population (20.0%). This difference in stage distribution between whites and blacks remained constant even when the effects of subsite and sex were controlled. The trends in Virginia data by race and by sex corresponded to trends in data reported by NCDB.[10]

Around the state, a greater percentage of laryngeal cancer was detected in later stages among residents of the Northwest region, while residents of the Northern region were diagnosed more often with early stage laryngeal cancer. The proportion of laryngeal cancer diagnosed in the early stages tended to increase with age. Trends of increasing frequency of Stage IV laryngeal cancer over time have been reported by NCDB.[9,10] Although Stage IV laryngeal cancer may be increasing in Virginia, changes in reporting and staging patterns make further analysis of this trend difficult.

Treatment

Table 3 shows that the most common treatment modalities in Virginia were radiation only (38.3%), surgery and radiation combined (30.1%), and surgery only (19.3%). Almost 88% of all laryngeal cancers were treated by one of these three forms of therapy. Virginia data showed a greater percentage of treatment with radiation only than reported by NCDB.[9] However, Virginia data showed twice the percentage of cases with no recorded treatment. The incomplete reporting of treatment procedures must be acknowledged when reviewing these data. The most common course of treatment for Virginians diagnosed with glottic cancer or supraglottic cancer during 1970-1996 was radiation only (See Appendix Table C-9). The most common treatment modality for tumors in the subglottis and all other subsites was the combination of surgery and radiation. Distribution of treatment modalities across subsite was similar to data reported by the NCDB.[9]

Table 3

Distribution of Laryngeal Cancer
Count and Percentage by First Course Treatment Combination, Virginia, 1970-1996
Percentage by First Course Treatment Combination, NCDB, 1990-1992

	Virginia 1970-1996		NCDB 1990-1992
TREATMENT COMBINATION	Count	%	%
Radiation	2,192	*38.3*	*34.5*
Surgery and Radiation	1,720	*30.1*	*35.3*
Surgery	1,105	*19.3*	*19.3*
Radiation and Chemotherapy	148	*2.6*	*4.4*
Surgery, Radiation and Chemotherapy	70	*1.2*	*1.9*
Chemotherapy	35	*0.6*	*0.9*
Surgery and Chemotherapy	19	*0.3*	*0.4*
No reported treatment	432	*7.6*	*3.3*
All Treatments	5,721	*100.0*	*100.0*

Note. Data include in situ carcinomas. Virginia data include 43 cases that received hormone therapy, immunotherapy, or other therapy in addition to the treatment combination specified. Virginia data from 1970 through 1996 were used for comparison purposes because no significant changes in treatment modalities over that time period were noted.

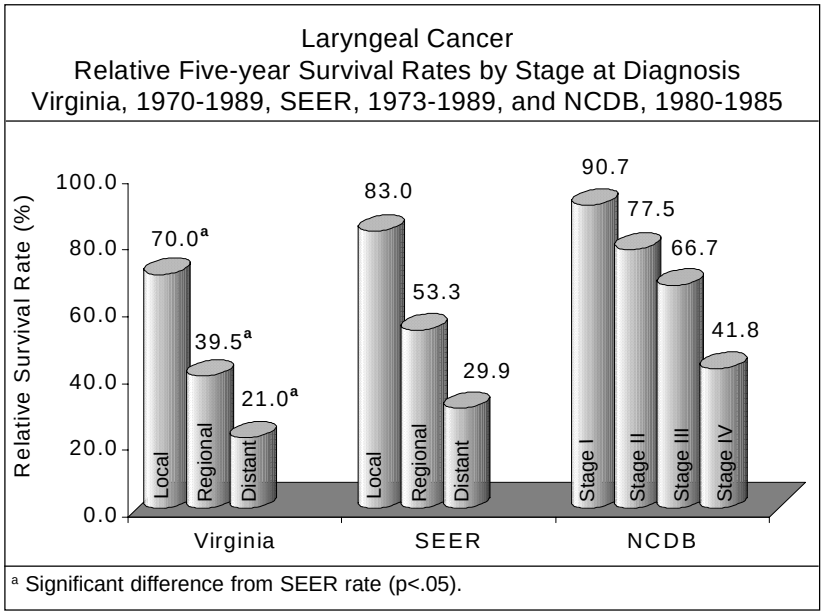
Even though the black population had a greater percentage of laryngeal cancer diagnosed in Stage IV, the percentage of blacks who received some combination of surgery, radiation, or chemotherapy was similar to that of whites or persons of other races. A greater percentage of persons age 60 years and over were treated by radiation only than were persons younger than 60. Northwest region residents diagnosed with laryngeal cancer were less likely (10.2%) to be treated by surgery only than were residents of other regions (17.1%-22.6%). In Virginia, there were no noted trends in treatment modalities between males and females or over time.

In laryngeal cancer diagnosed between 1990 and 1996, the most common treatment for Stage 0 or in situ tumors was surgery only (44.3%) (See Appendix Table C-10). Stage I and Stage II laryngeal cancers were most often treated with radiation only (50.7%). Almost 46% of Stage III cancer cases received either radiation only or surgery only, while another 35% received a combination of the two therapies. Over one-half of Stage IV laryngeal cancer was treated with combination radiation and surgical therapy. Concomitant use of chemotherapy was more common in late stage laryngeal cancers (11.4%). The distribution of treatment modalities across stage in Virginia was similar to data reported by the NCDB.[9]

Survival

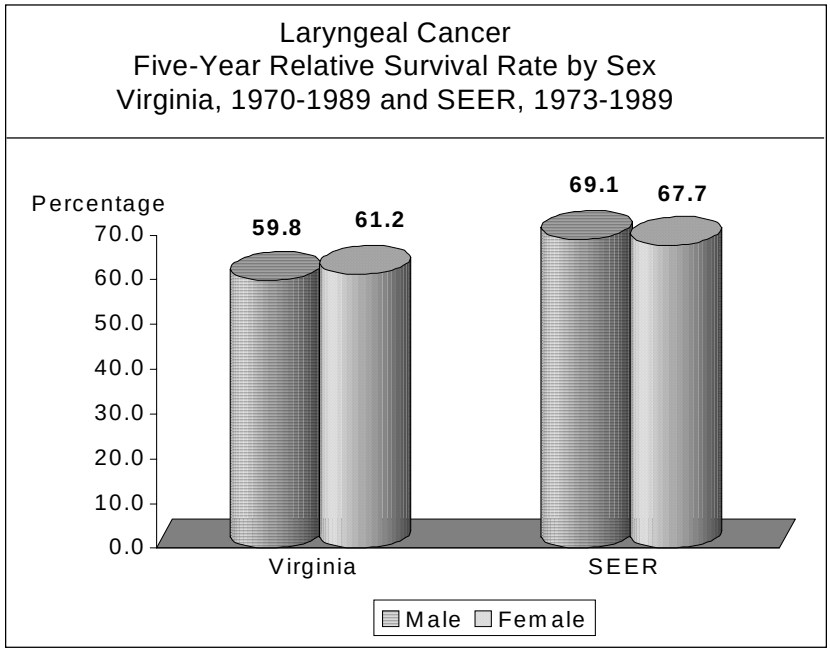
In Virginia, the relative five-year survival rate for all stages combined was 60% for cases diagnosed between 1970 and 1989 and was significantly lower than rates reported by SEER[2] or NCDB[9] (See Appendix Table C-11). As shown in Figure 4, the relative five-year survival rate ranged from 70% for localized cancers to 21% for cancers with distant metastasis.

Figure 4



Statewide male survival rates, but not female rates, were also found to be significantly lower than SEER survival rates. In Virginia, female survival rates were slightly higher than rates for males, while the reverse was seen in SEER data. This finding is illustrated in Figure 5. This disparity remained constant across SEER stages even when survival was analyzed by race and subsite. Nationwide, this pattern of higher female survival rates is usually not seen in the white population; however, black females generally do have higher survival rates than black men.

Figure 5



Appendix Table C-11 demonstrates that, although Virginia survival rates tended to be lower than those reported by the SEER program, survival patterns for different subpopulations followed national norms. Members of the white population were found to have higher survival rates than members of the black population. Patients diagnosed with tumors in the glottis showed higher survival rates than patients with supraglottic tumors. Survival by other separate subsites could not be determined due to insufficient numbers of cases. There were no significant difference in survival based on treatment modality. Around the state, there were no significant differences in survival among health regions.

An average of 97 Virginia residents died from laryngeal cancer each year from 1990 to 1996. These deaths represented an average of 0.8% of all cancer-related deaths during those years. In Virginia, the average annual mortality rate due to laryngeal cancer was 1.5 deaths per 100,000 persons, based on data from 1990-1996.[11]

Discussion

Overall incidence of laryngeal cancer in Virginia was higher than the national average. Whereas U.S. laryngeal cancer rates have declined in recent years, Virginia rates have remained constant. Statewide demographic trends, however, tended to follow patterns seen throughout the nation. Persons age 55 years and older were most frequently afflicted by the disease. Men were diagnosed four times more often than women. The incidence rate for the black population was higher than that of the white population.

Incidence of laryngeal cancer varied according to anatomic subsite. The glottis is the middle portion of the larynx and contains the vocal cords; overall it was the most common place for laryngeal cancer to develop. Among women, however, the supraglottis, the area between the pharynx and the true vocal cords, was the site where laryngeal cancer was diagnosed most frequently. Together, these two subsites accounted for 75% of all laryngeal cancer diagnosed in the Commonwealth. The subglottis is the lower part of the larynx that extends from just below the vocal cords to the beginning of the trachea and was an area where laryngeal cancer was rarely diagnosed.

Most laryngeal cancers have a cellular classification of squamous cell carcinoma, also known as epidermoid carcinoma, squamous carcinoma, or squamous cell epithelioma. This type of carcinoma arises from the surface cells of the mucous membranes in the larynx. Less frequently occurring cell types are verrucous carcinoma, adenocarcinoma, and sarcoma. In a pattern that follows SEER data, 95% of laryngeal cancer in Virginia were classified as squamous cell carcinoma.

Although most of the laryngeal cancer in Virginia was diagnosed in the early stages, the state still reported a higher percentage of late stage laryngeal cancer than either SEER or NCDB. Stage breakdowns were highly influenced by anatomical location of the tumor. Eighty percent of glottic cancer was detected in the early stages, while only 39% of supraglottic tumors were found in the early stages. Due to the influence of sex on subsite distribution, males were more likely to be diagnosed with early stage laryngeal cancer than were females. A greater percentage of blacks were likely to be diagnosed with late stage tumors than were whites, regardless of subsite or sex. Based on these findings, efforts toward risk reduction and early detection must be continued and enhanced, especially for blacks and females.

Overall, the data on Virginia laryngeal cancer showed that therapy administered conforms with standard treatment guidelines[12] and national comparison data.[9] The most common forms of treatment in Virginia were radiation only, surgery and radiation combined, and surgery only. The most common form of treatment for Stage I and Stage II laryngeal cancers was radiation only, while the most prevalent treatment modality for Stage III and Stage IV cancers was surgery and radiation combined. Concomitant use of chemotherapy was more common in late stage laryngeal cancers. Radiation only was the most common treatment modality for men diagnosed with glottic cancer, while women were more likely to be treated with a combination of surgery and radiation. Blacks were found to have received a smaller percentage of combination therapy than whites, even though the black population has a greater proportion of late stage laryngeal cancer than the white population. Incomplete reporting of laryngeal cancer treatment may have affected these data , however further investigation into these apparent trends would be useful.

Statewide, five-year survival rates for laryngeal cancer across all stages were significantly lower than the national averages. Contrary to findings from other sources,[2,13] Virginia women were found to have slightly better survival rates than men. In light of the

fact that females are generally diagnosed at a later stage than males, further investigation of this pattern would be beneficial. Virginia survival rates by subsite and race followed trends reported in previously published studies,[14] with lower survival rates for blacks and poorer prognosis for supraglottic tumors.

Recommendations for Prevention

Efforts to control laryngeal cancer can focus on primary prevention (risk reduction) and secondary prevention (early detection). Because the two principal risk factors are tobacco use and alcohol use, the most important strategies for primary prevention are avoiding alcohol and tobacco.[15] The combined use of tobacco and alcohol has been shown to have a multiplicative effect. That is, when tobacco and alcohol are both used, the risk of developing laryngeal cancer is greater than the sum of the risk of just using tobacco plus the risk of just using alcohol.[16-18] Several studies have also established the existence of dose-response effects of alcohol and tobacco. As the amount of alcohol and tobacco used increases, so does the risk of developing laryngeal cancer.[19-23]

Among the limitations of VCR data are the absence of alcohol and tobacco use history for the majority of cases. The relevant data are reported infrequently to the VCR. The collection of such vital information would prove invaluable in showing the impact of tobacco and alcohol use on cancer incidence in Virginia. This missing link can only by remedied by making the collection and reporting of tobacco and alcohol use a priority in the cancer registration process.

Smoking cessation has been shown to reduce laryngeal cancer risk, with the level of risk decreasing as the duration of smoking cessation increases.[24,25] A diet high in certain vitamins, including beta-carotene and vitamins C and E, has also been shown to reduce the risk of laryngeal cancer.[26,27] However, no diet, regardless of vitamin intake, can offset the hazards caused by alcohol and tobacco use.

Among the goals of the U.S. Department of Health and Human Services' Healthy People 2000 is the reduction of smoking prevalence among adults to no more than 15%.[28] As of 1997, the smoking prevalence among adults in Virginia is 24%, slightly above the national average of 23%.[29] Despite the implementation of smoking prevention and cessation programs such as the American Cancer Society's American Stop Smoking Intervention Study (ASSIST) and the Robert Wood Johnson / American Medical Association SmokeLess States Program, state smoking prevalence figures have shown little change during the 1990s.[30] Hopefully, continued efforts to reduce tobacco use among adults and to prevent children from starting smoking will eventually have an impact on tobacco use rates, and therefore, reduce the burden of smoking-related diseases such as laryngeal cancer.

Early detection of laryngeal cancers can prevent further morbidity and mortality and is possible due to the relative ease of examination by visual inspection with the use of a laryngoscope. However, depending on the part of the larynx involved, a patient may

have no symptoms to suggest the need for laryngeal examination.[14] A physician must be aware of the populations at highest risk for laryngeal cancer and be able to evaluate these patients appropriately. Counseling of all patients to avoid alcohol and tobacco products must also be emphasized.

Recommendations for Future Research

Treatment of laryngeal cancer has traditionally involved surgery, radiation, or a combination of both. Recent trends in laryngeal preservation techniques and increased patient involvement in treatment planning may be altering previous treatment practices. In particular, the use of chemoradiation and altered fractionation radiation therapy have gained in popularity. While initial results are promising, detailed functional evaluations and long-term oncologic results are pending.

Nevertheless, the keys to decreasing the impact of laryngeal cancer on Virginians remain prevention and early detection. This report demonstrated the high incidence rates of laryngeal cancer around the state. Since tobacco and alcohol use are the main risk factors for this cancer, education efforts should focus on reduction or cessation of the use of these products.

With regard to early detection, blacks and women tend to be diagnosed at later stages of disease. Patient and physician education are important in remedying this finding. Women, in particular, merit special consideration because they are prone to supraglottic cancer which tends to spread earlier and cause symptoms later than similarly staged glottic lesions.

It would be useful to reevaluate laryngeal cancer in Virginia after the implementation of these proposed education efforts to determine if incidence rates fall into line with national rates.

Appendix A: Technical Notes

Case Ascertainment

These data reflect a conservative account of cancer in Virginia. Residents sometimes travel out-of-state for diagnosis and treatment. While the Registry now maintains data exchange agreements with central registries in five of the six neighboring states (including the District of Columbia) to minimize the loss of reporting, not all states were collecting cancer reports during the early 1990s. Also, not all Virginia hospitals, outpatient facilities, and private pathology laboratories were reporting cases to the Registry during the 1990-1996 period. Further, some patients may have been missed by the routine casefinding methods used in reporting facilities. These factors combine to lead to biases in the cases that are reported. Underreporting of cancer occurs to varying degrees in different areas of the state; for example, counts may be more accurate in urbanized areas simply because the case ascertainment is more complete. Similarly, case reporting may be more complete for certain racial groups, cancer sites, or diagnosis stages. Note that age-adjusted rates for the Southwest region especially are consistently low. This will be remedied when the Virginia Cancer Registry begins exchanging cases with the central registry of the neighboring state in that region.

Population

Population data used to calculate age-specific and age-adjusted incidence rates were derived from two sources. Estimates for 1990 are the Modified Age-Race-Sex (MARS) population figures from the U.S. Bureau of the Census. Estimates for 1991, 1992, 1993, and 1994 were linearly imputed from the age-race-sex specific figures from the 1990 MARS data and from the 1995 population projections published by the Virginia Employment Commission's State Data Center. In order to calculate average annual incidence rates for 1990-1995, estimates for each of the six years were then summed for a total population-at-risk figure.

Incidence Rates

A cancer incidence rate reflects the number of new cases diagnosed per 100,000 individuals in a given population over a defined time period. Cancer rates tend to vary substantially by age, with higher rates of most cancers noted in older populations. This report provides both age-specific and age-adjusted incidence rates. Age-specific rates denote the incidence of cancer among persons within specific age categories (typically 0-4 years, 5-9 years, 10-14 years, etc., up to 85+ years). Age-adjusted rates are calculated by mapping age-specific rates onto a standard population to remove the effect of different age structures and to arrive at a single summary measure for comparison. The age-adjusted incidence rates were calculated by the direct method, using the age distribution of the 1970 United States population as the standard. Rates were calculated by sex, race, and region. Except where noted, all incidence rates are expressed per 100,000 persons per year and exclude in situ carcinomas. Some age-adjusted incidence rates in this report are average rates calculated by dividing the total cases during 1990-1995 by the sum of the annual population data for those years.

Mortality Rates

Age-adjusted mortality rates were obtained from the Virginia Center for Health Statistics. The cancer mortality rate reflects the number of deaths due to cancer per 100,000 individuals in a given area over a defined time period. Cancer death rates tend to vary substantially by age, with higher rates noted in older populations. This report provides the age-adjusted mortality rate for Virginia as a whole. The age-adjusted mortality rate was calculated by the direct method, using the age distribution of the 1970 United States population as the standard. The mortality rate is expressed per 100,000.

Relative Survival Rate

The relative survival rate is defined as the ratio of the observed survival rate of laryngeal cancer cases to the expected survival rate of a similar population over a defined period of time. The relative survival rate corrects for death from other outcomes and allows for comparison to a similar group of persons without cancer. As the relative survival rate approaches 100 percent, the survival experience of the study population more closely resembles the survival experience in the general population. Relative survival rates were calculated using Rocky Mountain Cancer Data Systems based on 1990 U.S. Life Tables from the National Center for Health Statistics by age and sex. Relative survival rates in this report are five-year survival rates.

Race Grouping

According to the modified 1990 U.S. Census data of February 1992, 78.3% of Virginia's population was white, 18.9% black, and 2.8% was of an other race, including Asian / Pacific Islander and Native American. Race-specific counts and rates could only be calculated for white, black, and other races, since reliable population estimates are not available for more specific racial populations.

Staging

The progression of laryngeal cancer is classified by categories or stages. Identifying the stage of laryngeal cancer at diagnosis is useful in evaluating prognosis and choosing treatment. Two summary staging systems are in use. The system advocated by the American College of Surgeons is the American Joint Committee on Cancer (AJCC) Tumor, Node and Metastasis (TNM) classification and stage grouping. This system incorporates "the identification of new prognostic factors which may influence choice of treatment."[31] To reflect advances in the understanding of cancer, the AJCC system has undergone several revisions since its inception in 1978. The system developed by the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program has not undergone any revisions since its inception in 1977. This system focuses more on the extent of disease and is more general in its categorization of stage. Because the stage categories have not changed since 1977, SEER staging is generally more appropriate to use when assessing stage trends over time. The two systems are outlined in the following tables.

AJCC Stage Grouping Classification[32]

Stage 0	Laryngeal cancer in situ, not an invasive lesion
Stage I	Tumor limited to subsite with normal vocal cord mobility
Stage II	Tumor extends to adjacent subsite and/or impaired vocal cord mobility but without fixation of vocal cords
Stage III	Tumor limited to larynx with vocal cord fixation which may be combined with metastasis in single lymph node less than 3cm in greatest dimension
Stage IV	Tumor invades through laryngeal cartilage and/or extends into tissues beyond larynx which may be combined with metastasis in single lymph node less than 3cm in greatest dimension OR Any tumor with metastasis in lymph node(s) more than 3cm in greatest dimension and/or metastasis to distant anatomical site(s)

SEER Summary Staging Classification[33]

In situ	Laryngeal cancer in situ, not an invasive lesion
Local	Tumor limited to larynx with or without fixation of vocal cords
Regional	Extension of tumor to adjacent anatomical sites and/or involvement of nearby lymph nodes
Distant	Metastasis to distant anatomical sites and/or distant lymph nodes

Appendix B: Health Regions

Virginia is made up of 95 counties and 40 cities, which are grouped into five regions by the Virginia Department of Health. The composition of the Health Regions and Health Districts is listed in the table below.

Health Region	Health District	Locality
NORTHWEST	Central Shenandoah	Counties of Augusta, Bath, Highland, Rockbridge, Rockingham; Cities of Buena Vista, Harrisonburg, Lexington, Staunton, Waynesboro
	Lord Fairfax	Counties of Clarke, Frederick, Page, Shenandoah, Warren; City of Winchester
	Rappahannock	Counties of Caroline, King George, Spotsylvania, Stafford; City of Fredericksburg
	Rappahannock / Rapidan	Counties of Culpepper, Fauqier, Madison, Orange, Rappahannock
	Thomas Jefferson	Counties of Albemarle, Fluvanna, Louisa, Nelson; City of Charlottesville
NORTH	Alexandria	City of Alexandria
	Arlington	County of Arlington
	Fairfax	County of Fairfax; Cities of Fairfax, Falls Church
	Loudoun	County of Loudoun
	Prince William	County of Prince William; Cities of Manassas,* Manassas Park*
SOUTHWEST	Alleghany	Counties of Alleghany, Botetourt, Craig, Roanoke; Cities of Clifton Forge, Covington, Salem
	Central Virginia	Counties of Amherst, Appomattox, Bedford, Campbell; Cities of Bedford, Lynchburg
	Cumberland Plateau	Counties of Buchanan, Dickenson, Russell, Tazewell
	Lenowisco	Counties of Lee, Scott, Wise; City of Norton
	Mount Rogers	Counties of Bland, Carroll, Grayson, Smyth, Washington, Wythe; Cities of Bristol, Galax
	New River	Counties of Floyd, Giles, Montgomery, Pulaski; City of Radford
	Pittsylvania / Danville	County of Pittsylvania; City of Danville
	Roanoke	City of Roanoke
	West Piedmont	Counties of Franklin, Henry, Patrick; City of Martinsville
CENTRAL	Chesterfield	Counties of Chesterfield, Powhatan; City of Colonial Heights
	Crater	Counties of Dinwiddie, Greensville, Prince George, Surry, Sussex; Cities of Emporia, Hopewell, Petersburg
	Hanover	Counties of Charles City, Goochland, Hanover, New Kent
	Henrico	County of Henrico
	Piedmont	Counties of Amelia, Buckingham, Charlotte, Cumberland, Lunenburg, Nottoway, Prince Edward
	Richmond	City of Richmond
	Southside	Counties of Brunswick, Halifax, Mecklenberg; City of South Boston
EAST	Chesapeake	City of Chesapeake
	Eastern Shore	Counties of Accomack, Northampton
	Hampton	City of Hampton
	Norfolk	City of Norfolk
	Peninsula	Counties of James City, York; Cities of Newport News, Poquoson, Williamsburg
	Portsmouth	City of Portsmouth
	Three Rivers	Counties of Essex, Gloucester, King and Queen, King William, Lancaster, Mathews, Middlesex, Northumberland, Richmond, Westmoreland
	Virginia Beach	City of Virginia Beach
	Western Tidewater	Counties of Isle of Wight, Southampton; Cities of Franklin, Suffolk

*The cities of Manassas and Manassas Park are analyzed together with Prince William County.

Appendix C: Data Tables

Table C-1
Distribution of Laryngeal Cancer, Virginia, 1990-1996
Count and Percentage by Year of Diagnosis

YEAR	Count	%
1990	322	*1.5*
1991	300	*1.2*
1992	283	*1.1*
1993	334	*1.3*
1994	326	*1.3*
1995	337	*1.3*
1996	327	*1.3*
1990-1996	**2,229**	***1.3***

Note. Data include in situ carcinomas.

Table C-2
Distribution of Invasive Laryngeal Cancer, Virginia, 1990-1995
Comparison of Regional Incidence Rates to Virginia and SEER

	1990-1995		1990	1991	1992	1993	1994	1995
	Rate	Count	Rate	Rate	Rate	Rate	Rate	Rate
Northwest	4.8	272	4.2	6.0	4.6	4.6	4.4	5.2
North	2.9 [a,b]	214	3.8	3.1	2.0 [a,b]	2.9 [b]	3.0 [a,b]	2.5 [a,b]
Southwest	4.3	397	4.3	4.1	4.2	4.2	4.8	4.3
Central	5.7 [a,b]	403	6.8 [a]	4.8	4.5	6.8 [a]	5.3	5.8 [a,b]
East	5.7 [a,b]	516	6.0	4.6	5.8	5.9 [a]	5.7 [b]	6.0 [a,b]
Virginia	4.6 [a]	1,802	4.9	4.4	4.2	4.9 [a]	4.7	4.7 [a]
SEER	4.2	6,323	4.5	4.2	4.5	3.9	4.2	3.8

Note. Rates are age-adjusted to the 1970 US population, are per 100,000 persons, and are based on invasive cases only.

[a] Significant difference from SEER rate ($p<.05$).

[b] Significant difference from Virginia rate ($p<.05$).

Table C-3
Distribution of Laryngeal Cancer
Count by Health Region and Health District, Virginia, 1970-1996
Invasive Incidence Rate by Health Region and Health District, Virginia and SEER, 1990-1995

		1970-1996	1990-1995 Rate per 100,000	
HEALTH REGION	HEALTH DISTRICT	Count	Count	Rate
Northwest		**837**	**272**	**4.8**
	Central Shenandoah	235	78	4.9
	Lord Fairfax	220	70	5.9 [a]
	Rappahanock	125	40	4.8
	Rappahanock/Rapidan	104	35	3.5
	Thomas Jefferson	153	49	4.7
North		**626**	**214**	**2.9** [a,b]
	Alexandria	93	22	3.4
	Arlington	97	32	3.1 [b]
	Fairfax	301	109	2.5 [a,b]
	Loudoun	51	14	2.8 [b]
	Prince William	84	37	4.5
Southwest		**1,276**	**397**	**4.3**
	Alleghany	136	46	3.6
	Central Virginia	250	68	4.5
	Cumberland Plateau	78	32	3.8
	Lenowisco	35	11	1.7 [a,b]
	Mount Rogers	126	46	3.4 [b]
	New River	128	43	4.7
	Pittsylvania/Danville	181	46	5.3
	Roanoke City	179	45	6.2 [a]
	West Piedmont	163	60	5.9 [a]
Central		**1,247**	**403**	**5.7** [a,b]
	Chesterfield	137	63	4.9
	Crater	192	57	6.0 [a]
	Hanover	108	36	5.6
	Henrico	125	54	3.7
	Piedmont	122	45	7.1 [a,b]
	Richmond City	435	105	7.8 [a,b]
	Southside	128	43	6.2 [a]
East		**1,719**	**516**	**5.7** [a,b]
	Chesapeake	158	44	5.1
	Eastern Shore	51	19	5.1
	Hampton	145	40	5.2
	Norfolk	399	106	8.0 [a,b]
	Peninsula	232	78	5.1
	Portsmouth	141	36	5.2
	Three Rivers	166	56	5.4
	Virginia Beach	270	83	4.7
	Western Tidewater	157	54	7.2 [a,b]
Virginia		**5,721**	**1,802**	**4.6** [a]
SEER			**6,323**	**4.2**

Note. Count and percentage data for 1970-1996 include in situ carcinomas. Total figures include 16 cases of unknown Virginia residence. Rates are age-adjusted to the 1970 US population and are based on invasive cases only.

[a] Significant difference from SEER rate ($p<.05$).

[b] Significant difference from Virginia rate ($p<.05$).

Table C-4
Distribution of Laryngeal Cancer
Count and Percentage by Age at Diagnosis, Virginia, 1970-1996
Age-Specific Invasive Incidence Rate by Five-Year Age Group, Virginia and SEER, 1990-1995

	1970-1996		1990-1995 Invasive Rate per 100,000	
AGE	Count	%	VA	SEER
0 to 4	0	--	0.0	0.0
5 to 9	0	--	0.0	0.0
10 to 14	0	--	0.0	0.0
15 to 19	0	--	0.0	0.0
20 to 24	3	*0.1*	0.0	0.1
25 to 29	8	*0.1*	0.1	0.1
30 to 34	21	*0.4*	0.3	0.2
35 to 39	73	*1.3*	0.8	0.5
40 to 44	151	*2.6*	1.8	1.5
45 to 49	350	*6.1*	4.1	3.7
50 to 54	649	*11.3*	9.1	7.8
55 to 59	875	*15.3*	13.4	12.9
60 to 64	1,044	*18.2*	19.7	17.9
65 to 69	1,039	*18.2*	26.8	23.2
70 to 74	797	*13.9*	26.5 [a]	20.7
75 to 79	435	*7.6*	20.5	21.5
80 to 84	196	*3.4*	12.6	15.1
85 and older	80	*1.4*	6.7	8.7
All Ages	**5,721**	***100.0***		

Note. Count and percentage data for 1970-1996 include in situ carcinomas. Rates are average annual age-specific incidence rates and are based on invasive cases only.
[a] Significant difference from SEER rate ($p<.05$).

Table C-5
Distribution of Laryngeal Cancer, Virginia, 1970-1996
Count and Percentage by Histologic Type

HISTOLOGIC TYPE	Count	%
Squamous cell	5,430	*94.9*
Verrucous	44	*0.8*
Adenocarcinoma	32	*0.6*
Other carcinoma	198	*3.5*
Other histologic type	17	*0.3*
All Sites	**5,721**	***100.0***

Note. Data include in situ carcinomas.

Table C-6
Distribution of Laryngeal Cancer, Virginia, 1970-1996
Count and Percentage of Subsite by Sex and Age at Diagnosis

Males

	Glottis		Supraglottis		Subglottis		All Other Laryngeal Subsites	
AGE	Count	%	Count	%	Count	%	Count	%
0 to 19	0	--	0	--	0	--	0	--
20 to 29	6	*85.7*	1	*14.3*	0	--	0	--
30 to 39	35	*52.2*	14	*20.9*	2	*3.0*	16	*23.9*
40 to 49	169	*44.8*	128	*34.0*	3	*0.8*	77	*20.4*
50 to 59	559	*46.3*	319	*26.4*	11	*0.9*	318	*26.3*
60 to 69	854	*49.7*	411	*23.9*	26	*1.5*	429	*24.9*
70 to 79	577	*56.2*	212	*20.7*	15	*1.5*	222	*21.6*
80 and older	137	*59.8*	42	*18.3*	5	*2.2*	45	*19.7*
All Ages	**2,337**	***46.3***	**1,127**	***28.7***	**62**	***1.9***	**1,107**	***23.2***

Females

	Glottis		Supraglottis		Subglottis		All Other Laryngeal Subsites	
AGE	Count	%	Count	%	Count	%	Count	%
0 to 19	0	--	0	--	0	--	0	--
20 to 29	2	*50.0*	0	--	0	--	2	*50.0*
30 to 39	13	*48.1*	8	*29.6*	0	--	6	*22.2*
40 to 49	36	*29.0*	52	*41.9*	0	--	36	*29.0*
50 to 59	68	*21.5*	173	*54.6*	5	*1.6*	71	*22.4*
60 to 69	102	*28.1*	178	*49.0*	3	*0.8*	80	*22.0*
70 to 79	69	*33.5*	89	*43.2*	5	*2.4*	43	*20.9*
80 and older	19	*40.4*	16	*34.0*	0	--	12	*25.5*
All Ages	**309**	***28.4***	**516**	***47.4***	**13**	***1.2***	**250**	***23.0***

Note. All other laryngeal subsites include laryngeal cartilage, overlapping lesion, and larynx, NOS. Data include in situ carcinomas. Row percentages reflect the percentage of laryngeal cancer arising in each subsite. Percentages may not sum to 100 due to rounding.

Table C-7
Anatomic Distribution of Laryngeal Cancer, Virginia, 1970-1996
Count and Percentage by Selected Demographics, Health Region, And Year of Diagnosis

	Glottis		Supraglottis		Subglottis		All Other Laryngeal Subsites	
	Count	%	Count	%	Count	%	Count	%
SEX								
Male	2,337	*50.4*	1,127	*24.3*	62	*1.3*	1,107	*23.9*
Female	309	*28.4*	516	*47.4*	13	*1.2*	250	*23.0*
RACE								
White	2,099	*47.9*	1,245	*28.4*	63	*1.4*	973	*22.2*
Black	532	*40.8*	393	*30.1*	12	*0.9*	368	*28.2*
Other	6	*30.0*	4	*20.0*	0	--	10	*50.0*
REGION								
Northwest	374	*44.7*	308	*36.8*	11	*1.3*	144	*17.2*
North	341	*54.5*	165	*26.4*	10	*1.6*	110	*17.6*
Southwest	583	*45.7*	361	*28.3*	18	*1.4*	314	*24.6*
Central	630	*50.5*	353	*28.3*	13	*1.0*	251	*20.1*
East	711	*41.4*	453	*26.4*	23	*1.3*	532	*30.9*
YEAR OF DIAGNOSIS								
1970-1974	112	*38.0*	61	*20.7*	1	*0.3*	121	*41.0*
1975-1979	269	*44.0*	98	*16.0*	3	*0.5*	241	*39.4*
1980-1984	514	*42.9*	275	*23.0*	12	*1.0*	397	*33.1*
1985-1989	676	*48.7*	427	*30.8*	16	*1.2*	269	*19.4*
1990	168	*52.2*	103	*32.0*	7	*2.2*	44	*13.7*
1991	139	*46.3*	98	*32.7*	3	*1.0*	60	*20.0*
1992	138	*48.8*	103	*36.4*	4	*1.4*	38	*13.4*
1993	157	*47.0*	117	*35.0*	9	*2.7*	51	*15.3*
1994	156	*47.9*	116	*35.6*	7	*2.1*	47	*14.4*
1995	158	*46.9*	136	*40.4*	5	*1.5*	38	*11.3*
1996	159	*48.6*	109	*33.3*	8	*2.4*	51	*15.6*
VIRGINIA	**2,646**	***46.3***	**1,643**	***28.7***	**75**	***1.3***	**1,357**	***23.7***

Note. All other laryngeal subsites include laryngeal cartilage, overlapping lesion, and larynx, NOS. Data include in situ carcinomas. Virginia figures include 16 cases of unknown Virginia residence and 16 cases of unknown race. Row percentages reflect the percentage of laryngeal cancer arising in each subsite. Percentages may not sum to 100 due to rounding.

Table C-8
Distribution of Laryngeal Cancer, Virginia, 1990-1996
Count and Percentage of AJCC Stage Grouping by Subsite,
Selected Demographics, Health Region, and Year of Diagnosis

	Stage 0		Stage I		Stage II		Stage III		Stage IV		Total Staged
	Count	%	Count	%	Count	%	Count	%	Count	%	Count
SUBSITE											
Glottis	75	*8.6*	474	*54.0*	153	*17.4*	100	*11.4*	75	*8.6*	877
Supraglottis	7	*1.1*	112	*17.4*	128	*19.9*	157	*24.5*	238	*37.1*	642
Subglottis	1	*2.6*	9	*23.7*	4	*10.5*	6	*15.8*	18	*47.4*	38
All Other Subsites	5	*2.1*	48	*20.4*	42	*17.9*	60	*25.5*	80	*34.0*	235
SEX											
Male	74	*5.2*	532	*37.7*	250	*17.7*	250	*17.7*	306	*21.7*	1,412
Female	14	*3.7*	111	*29.2*	77	*20.3*	73	*19.2*	105	*27.6*	380
RACE											
White	64	*4.6*	525	*38.0*	258	*18.7*	258	*18.7*	277	*20.0*	1,382
Black	23	*5.8*	111	*28.0*	67	*16.9*	65	*16.4*	130	*32.8*	396
Other	0	--	2	*33.3*	2	*33.3*	0	--	2	*33.3*	6
AGE											
0 to 19	0	--	0	--	0	--	0	--	0	--	0
20 to 29	0	--	1	*100.0*	0	--	0	--	0	--	1
30 to 39	2	*5.7*	12	*34.3*	3	*8.6*	7	*20.0*	11	*31.4*	35
40 to 49	3	*2.1*	49	*33.8*	20	*13.8*	39	*26.9*	34	*23.4*	145
50 to 59	17	*4.2*	111	*27.3*	79	*19.4*	80	*19.7*	120	*29.5*	407
60 to 69	26	*4.0*	241	*37.0*	136	*20.9*	103	*15.8*	146	*22.4*	652
70 to 79	30	*6.6*	195	*42.9*	69	*15.2*	77	*16.9*	84	*18.5*	455
80 and older	10	*10.3*	34	*35.1*	20	*20.6*	17	17.5	16	*16.5*	97
REGION											
Northwest	8	*3.1*	79	*30.3*	44	*16.9*	73	*28.0*	57	*21.8*	261
North	14	*6.1*	95	*41.3*	43	*18.7*	35	*15.2*	43	*18.7*	230
Southwest	18	*4.7*	135	*35.3*	75	*19.6*	75	*19.6*	79	*20.7*	382
Central	21	*5.3*	156	*39.5*	73	*18.5*	59	*14.9*	86	*21.8*	395
East	27	*5.2*	178	*34.0*	92	*17.6*	80	*15.3*	146	*27.9*	523
YEAR OF DIAGNOSIS											
1990	11	*4.8*	91	*39.6*	43	*18.7*	42	*18.3*	43	*18.7*	230
1991	11	*4.5*	108	*43.7*	31	*12.6*	48	*19.4*	49	*19.8*	247
1992	11	*4.6*	92	*38.7*	39	*16.4*	46	*19.3*	50	*21.0*	238
1993	15	*4.9*	106	*34.5*	55	*17.9*	59	*19.2*	72	*23.5*	307
1994	14	*4.8*	98	*33.6*	57	*19.5*	48	*16.4*	75	*25.7*	292
1995	14	*4.9*	98	*34.5*	61	*21.5*	50	*17.6*	61	*21.5*	284
1996	12	*6.2*	50	*25.8*	41	*21.1*	30	*15.5*	61	*31.4*	194
VIRGINIA	**88**	***4.9***	**643**	***35.9***	**327**	***18.2***	**323**	***18.0***	**411**	***22.9***	**1,792**

Note. Total figures include 8 cases of unknown race and 1 case of unknown region. Data exclude 437 cases (19.6% of all laryngeal cancer) that are unstaged or missing stage data. Row percentages reflect the percentage of staged cases diagnosed at each stage. Percentages may not sum to 100 due to rounding.

Table C-9
Distribution of Laryngeal Cancer, Virginia, 1970-1996
Count and Percentage of First Course Treatment Combination by Subsite, Selected Demographics, Health Region, and Year of Diagnosis

	Radiation		Surgery and Radiation		Surgery		Radiation and Chemotherapy		Surgery, Radiation and Chemotherapy		Chemotherapy		Surgery and Chemotherapy		No Reported Treatment	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
SUBSITE																
Glottis	1,154	*43.6*	699	*26.4*	553	*20.9*	33	*1.2*	15	*0.6*	5	*0.2*	7	*0.3*	180	*6.8*
Supraglottis	593	*36.1*	556	*33.8*	225	*13.7*	81	*4.9*	38	*2.3*	21	*1.3*	6	*0.4*	123	*7.5*
Subglottis	23	*30.7*	26	*34.7*	15	*20.0*	3	*4.0*	1	*1.3*	0	--	1	*1.3*	6	*8.0*
All Other Subsites	422	*31.1*	439	*32.4*	312	*23.0*	31	*2.3*	16	*1.2*	9	*0.7*	5	*0.4*	123	*9.1*
RACE																
White	1,732	*39.5*	1,304	*29.8*	827	*18.9*	118	*2.7*	56	*1.3*	17	*0.4*	11	*0.3*	315	*7.2*
Black	451	*34.6*	408	*31.3*	271	*20.8*	28	*2.1*	14	*1.1*	17	*1.3*	8	*0.6*	108	*8.3*
Other	7	*35.0*	5	*25.0*	3	*15.0*	1	*5.0*	0	--	1	*5.0*	0	--	3	*15.0*
AGE																
0 to 19	0	--	0	--	0	--	0	--	0	--	0	--	0	--	0	--
20 to 29	4	*36.4*	3	*27.3*	3	*27.3*	0	--	0	--	0	--	0	--	1	*9.1*
30 to 39	31	*33.0*	34	*36.2*	20	*21.3*	3	*3.2*	1	*1.1*	1	*1.1*	1	*1.1*	3	*3.2*
40 to 49	158	*31.5*	162	*32.3*	108	*21.6*	13	*2.6*	12	*2.4*	5	*1.0*	2	*0.4*	41	*8.2*
50 to 59	512	*33.6*	525	*34.4*	310	*20.3*	51	*3.3*	19	*1.2*	8	*0.5*	4	*0.3*	95	*6.2*
60 to 69	816	*39.2*	620	*29.8*	414	*19.9*	48	*2.3*	31	*1.5*	13	*0.6*	6	*0.3*	135	*6.5*
70 to 79	539	*43.8*	324	*26.3*	204	*16.6*	28	*2.3*	5	*0.4*	8	*0.6*	5	*0.4*	119	*9.7*
80 and older	132	*47.8*	52	*18.8*	46	*16.7*	5	*1.8*	2	*0.7*	0	--	1	*0.4*	38	*13.8*
REGION																
Northwest	358	*42.8*	267	*31.9*	85	*10.2*	32	*3.8*	23	*2.7*	10	*1.2*	6	*0.7*	56	*6.7*
North	253	*40.4*	183	*29.2*	107	*17.1*	24	*3.8*	9	*1.4*	7	*1.1*	2	*0.3*	41	*6.5*
Southwest	463	*36.3*	369	*28.9*	267	*20.9*	43	*3.4*	16	*1.3*	2	*0.2*	2	*0.2*	114	*8.9*
Central	476	*38.2*	379	*30.4*	253	*20.3*	18	*1.4*	12	*1.0*	4	*0.3*	5	*0.4*	100	*8.0*
East	637	*37.1*	517	*30.1*	389	*22.6*	31	*1.8*	10	*0.6*	12	*0.7*	4	*0.2*	119	*6.9*
YEAR OF DIAGNOSIS																
1970-1974	132	*44.7*	59	*20.0*	83	*28.1*	5	*1.7*	1	*0.3*	0	--	0	--	15	*5.1*
1975-1979	280	*45.8*	150	*24.5*	134	*21.9*	5	*0.8*	3	*0.5*	2	*0.3*	3	*0.5*	34	*5.6*
1980-1984	487	*40.7*	364	*30.4*	248	*20.7*	23	*1.9*	8	*0.7*	4	*0.3*	1	*0.1*	63	*5.3*
1985-1989	513	*37.0*	445	*32.1*	276	*19.9*	33	*2.4*	22	*1.6*	11	*0.8*	6	*0.4*	82	*5.9*
1990	114	*35.4*	100	*31.1*	59	*18.3*	9	*2.8*	6	*1.9*	1	*0.3*	0	--	33	*10.2*
1991	92	*30.7*	104	*34.7*	55	*18.3*	5	*1.7*	5	*1.7*	2	*0.7*	1	*0.3*	36	*12.0*
1992	104	*36.7*	80	*28.3*	40	*14.1*	12	*4.2*	5	*1.8*	1	*0.4*	0	--	41	*14.5*
1993	113	*33.8*	117	*35.0*	52	*15.6*	11	*3.3*	5	*1.5*	2	*0.6*	2	*0.6*	32	*9.6*
1994	113	*34.7*	106	*32.5*	61	*18.7*	13	*4.0*	6	*1.8*	0	--	1	*0.3*	26	*8.0*
1995	121	*35.9*	104	*30.9*	51	*15.1*	14	*4.2*	2	*0.6*	6	*1.8*	5	*1.5*	34	*10.1*
1996	123	*37.6*	91	*27.8*	46	*14.1*	18	*5.5*	7	*2.1*	6	*1.8*	0	--	36	*11.0*
VIRGINIA	**2,192**	***38.3***	**1,720**	***30.1***	**1,105**	***19.3***	**148**	***2.6***	**70**	***1.2***	**35**	***0.6***	**19**	***0.3***	**432**	***7.6***

Note. All other laryngeal subsites include laryngeal cartilage, overlapping lesion, and larynx, NOS. Data include in situ carcinomas. Data include 43 cases that received hormone therapy, immunotherapy, or other therapy in addition to the treatment combination specified. Total figures include 16 cases of unknown Virginia residence and 16 cases of unknown race. Row percentages reflect the percentage of total cases receiving each treatment combination. Percentages may not sum to 100 due to rounding.

Table C-10
Distribution of Laryngeal Cancer, Virginia, 1990-1996
Count and Percentage of First Course Treatment Combination by AJCC Stage Grouping

	Total Staged		Stage 0		Stage I		Stage II		Stage III		Stage I
TREATMENT COMBINATION	Count	*%*	Count	%	Count	*%*	Count	*%*	Count	*%*	Count
Radiation	667	*37.2*	26	*29.5*	303	*47.1*	189	*57.8*	88	*27.2*	61
Surgery and Radiation	629	*35.1*	13	*14.8*	206	*32.0*	70	*21.4*	116	*35.9*	224
Surgery	285	*15.9*	39	*44.3*	96	*14.9*	45	*13.8*	59	*18.3*	46
Radiation and Chemotherapy	67	*3.7*	0	--	6	*0.9*	7	*2.1*	28	*8.7*	26
Surgery, Radiation and Chemotherapy	31	*1.7*	1	*1.1*	2	*0.3*	5	*1.5*	7	*2.2*	16
Chemotherapy	15	*0.8*	0	--	0	--	0	--	7	*2.2*	8
Surgery and Chemotherapy	9	*0.5*	0	--	1	*0.2*	1	*0.3*	5	*1.5*	2
No Reported Treatment	89	*5.0*	9	*10.2*	29	*4.5*	10	*3.1*	13	*4.0*	28
All Treatments	**1,792**	***100.0***	**88**	***100.0***	**643**	***100.0***	**327**	***100.0***	**323**	***100.0***	**411**

Note. Data include 41 cases that received hormone therapy, immunotherapy, or other therapy in addition to the treatment combination specified. Data exclude 437 cases (19.6% of all laryngeal cancer) that are unstaged or missing stage data. Percentages may not sum to 100 due to rounding.

Table C-11
Distribution of Laryngeal Cancer, Virginia
Five-year Relative Survival Rate by Stage, Sex, Race, Subsite, and Treatment, Virginia and SEER
Five-year Relative Survival Rate by Health Region, Virginia

	Virginia 1970-1989	SEER 1973-1989
ALL CASES	60.0 [a]	68.6
STAGE		
Local	70.0 [a]	83.0
Regional	39.5 [a]	53.3
Distant	21.0 [a]	29.9
SEX		
Males	59.8 [a]	69.1
Females	61.2	67.7
RACE		
White	62.8 [a]	69.9
White Males	62.5 [a]	70.4
White Females	64.1	67.7
Black	50.9 [a]	58.1
Black Males	50.7 [a]	57.9
Black Females	52.3	59.0
SUBSITE		
All Glottis	74.1 [a]	84.0
Male Glottis	73.4 [a]	84.0
Female Glottis	78.7	84.0
All Supraglottis	48.4	50.4
Male Supraglottis	44.6	48.1
Female Supraglottis	56.8	56.3
TREATMENT		
Surgery Only	68.8	71.4
Males	68.4	71.4
Females	71.1	71.7
White	72.9	72.5
Black	57.7	62.3
Glottis	77.8	86.0
Supraglottis	58.3	55.6
Radiation Only	60.9 [a]	67.5
Males	61.2 [a]	68.1
Females	59.1	65.0
White	62.0 [a]	68.9
Black	56.4	56.3
Glottis	73.6 [a]	83.3
Supraglottis	44.8	48.7
Surgery and Radiation	59.5 [a]	67.5
Males	58.7 [a]	67.2
Females	62.7	67.2
White	63.8	68.6
Black	47.0	56.2
Glottis	75.2	84.4
Supraglottis	55.1	51.5
REGION		
Southwest	64.2	n/a
North	63.1	n/a
Northwest	60.7	n/a
Central	57.9	n/a
East	57.0	n/a

Note. Data include in situ carcinomas.
[a] Significant difference from SEER rate ($p<.05$).

References

[1] *Cancer Facts and Figures - 1999.* Atlanta, GA: American Cancer Society, 1999 (Available online at http://www3.cancer.org).

[2] Surveillance, Epidemiology, and End Results (SEER) Program Public-Use CD-ROM (1973-1995), National Cancer Institute, DCPC, Surveillance Program, Cancer Statistics Branch, released April 1998, based on the August 1997 submission.

[3] *Code of Virginia* §32.1-70.

[4] Percy C, Van Holten V, Muir C, eds. *International Classification of Diseases for Oncology*, 2nd ed. Geneva, World Health Organization, 1990.

[5] Rocky Mountain Cancer Data Systems. 1996, Salt Lake City: University of Utah.

[6] SPSS for Windows, Release 6.1.3. 1995, Chicago: SPSS, Inc.

[7] SEERPrep, Version 1.0 (Beta 3). 1998, Silver Springs, MD: Information Management Services, Inc.

[8] SEERStat, Version 1.1. 1998, Silver Springs, MD: Information Management Services, Inc.

[9] Shah JP, Karnell LH, Hoffman HT, Ariyan S, Brown GS, Fee WE, Glass AG, Goepfert H, Ossoff RH, Fremgen A. Patterns of care for cancer of the larynx in the United States. *Arch Otolaryngol Head Neck Surg* 1997; 123:475-483.

[10] Hoffman HT, Karnell LH. Laryngeal cancer. In: Steele GD, Jessup JM, Winchester DP, Menck HR, Murphy GP, eds. *National Cancer Data Base Annual Review of Patient Care, 1995*. Atlanta, GA: American Cancer Society, 1995: 84-99.

[11] Data compiled by the Virginia Department of Health, Virginia Center for Health Statistics.

[12] PDQ Information for Health Professionals: Laryngeal Cancer. Bethesda, MD: National Cancer Institute, 1998.

[13] Kokoska MS, Piccirillo JF, Haughey BH. Gender differences in cancer of the larynx. *Ann Otol Rhino Laryngol* 1995; 104:419-424.

[14] Austin DF, Reynolds P. Laryngeal cancer. In: Schottenfeld D, Fraumeni JF, Jr, eds. *Cancer Epidemiology and Prevention*, 2nd ed. New York: Oxford, 1996: 619-636.

[15] Wynder EL, Covey LS, Mabuchi K, Mushinski M. Environmental factors in cancer of the larynx: a second look. *Cancer* 1976; 38:1591-1601.

[16] Luce D, Guenel P, Leclerc A, Brugere J, Point D, Rodriguez J. Alcohol and tobacco consumption in cancer of the mouth, pharynx and larynx: a study of 316 female patients. *Laryngoscope* 1988; 98:313-316.

[17] Tuyns AJ, Esteve J, Raymond L, Berrino F, Benhamou E, Blanchet F, Bofetta P, Crosagnani P, delMoral A, Lehmann W, et al. Cancer of the larynx, hypopharynx, tobacco and alcohol: IARC international case-control study in Turin and Varese (Italy), Zaragosa and Navarra (Spain), Geneva (Switzerland), Calvados (France). *Intl J Cancer* 1988; 41:483-491.

[18] Bridges GP, Reay-Young P. Laryngeal cancer and smoking. *Med J Aust* 1976; ii:293-294.

[19] Wynder EL, Stellman SD. Comparative epidemiology of tobacco-related cancers. *Cancer Res* 1977; 37:4608-4622.

[20] Brownson RC, Chang JC. Exposure to alcohol and tobacco and the risk of laryngeal cancer. *Arch Environ Health* 1987; 42:192-196.

[21] Cann CI, Fried MP. Determinants and prognosis of laryngeal cancer. *Otolaryngol Clin North Am* 1984; 17:139-150.

[22] Choi SY, Kayho H. Effect of cigarette smoking and alcohol consumption in the aetiology of cancer in the oral cavity, pharynx and larynx. *Intl J Epidemiol* 1991; 20:878-885.

[23] Spitz MR, Fueger JJ, Geopfert H, Hong WK, Newell GR. Squamous call carcinoma of the upper aerodigestive tract: a case comparison analysis. *Cancer* 1988; 61:203-280.

[24] Francheschi S, Talamini R, Barra S, Baron AE, Negri E, Bidoli E, Serraino D, Lavaccchia C. Smoking and drinking in relation to cancers of the oral cavity, pharynx, larynx, and esophagus in northern Italy. *Cancer Res* 1990; 50:6502-6507.

[25] Esteve J, Riboli E, Tuyns AJ. Laryngeal and pharyngeal cancer: case-control study in southwestern Europe. *IARC Biennial Report, 1988-1989*. Lyon: International Agency for Research against Cancer, 1989: 54.

[26] Mackerras D, Buffler PA, Randall DE, Nachaman NZ, Pickle MZ, Mason TJ. Carotene intake and the risk of laryngeal cancer in coastal Texas. *Am J Epidemiol* 1988; 128:980-988.

[27] *Healthy People 2000: Midcourse Review and 1995 Revisions*. Bethesda, MD: US Department of Health and Human Services, Public Health Service, 1996.

[28] Smoking Prevalence among U.S. Adults Fact Sheet. Atlanta, GA: Centers for Disease Control and Prevention, Office on Smoking and Health, 1996.

[29] Data compiled by the Virginia Department of Health, Office of Family Health Services, from the Behavioral Risk Factor Surveillance System, 1990-1997.

[30] Sessions RB, Harrison LB, Hong WK. Tumors of the larynx and hypopharynx. In: DeVita VT, Hellman S, Rosenberg SA, eds. *Cancer: Principles and Practice of Oncology*, 4th ed. Philadelphia: Lippincott, 1993: 631-655.

[31] Kosary CL, Ries LAG, Miller BA, Hankey BF, Harras A, Edwards BK, eds. *SEER Cancer Statistics Review*, 1973-1992: *Tables and Graphs*. Bethesda, MD: National Cancer Institute, 1995.

[32] Larynx. In: *American Joint Committee on Cancer: Handbook of Staging for Cancer*, 4th ed. Philadelphia: Lippincott, 1993: 41-46.

[33] Shambaugh EM, Weiss MA. Laryngeal cancer. In: *Summary Staging Guide: Cancer Surveillance Epidemiology and End Results Reporting*. Bethesda, MD: National Cancer Institute, 1977: 96-98.